

REMARKS

This paper is filed in response to the Office Action mailed on February 4, 2005. Claims 1-14 stand rejected; claims 1, 4-6, 8 and 11-13 have been amended; claim 7 and 14 have been canceled; claims 1-6 and 8-13 remain pending.

In the Office Action, the specification is objected to. In response, the informalities on pages 5 and 6 have been corrected.

Claim 1 is also objected to due to an informality. In response, claim 1 has been corrected to traverse this objection.

Claims 6-7 and 13-14 stand rejected under 35 U.S.C. §112, second paragraph as allegedly being indefinite. Claims 7 and 14 have been cancelled and claims 6 and 13 have been substantially amended to render the indefinite misrejection moot. Specifically, claims 6 and 13 have been amended to set a target polishing thickness equal to the thickness of the copper layer (claim 6) and claim 13 has been amended to recite that the electro-polishing process is stopped if the copper barrier metal layer is exposed. Applicants respectfully submit that claims 6 and 13 is sufficiently definite. Support for the changes made to claim 13 appears in the paragraph extending from lines 1-16 of claim 7 and elsewhere throughout the specification as filed.

Turning to the rejections based upon the prior art, the Office Action rejects claims 1-12 under 35 U.S.C. §103 as being unpatentable over applicant's admitted prior art (AAPA) in view of U.S. Patent Application No. 2002/0115283 ("Ho") and claims 13-14 as being obvious in view of the AAPA, Ho and U.S. Patent No. 6,653,226 ("Reid").

In response, independent claims 1 and 8 have been amended to traverse this rejection and Applicants respectfully submit that any obviousness rejection based upon AAPA, Ho with or without Reid is improper for the following reasons. Specifically, under MPEP § 2142,

[t]o establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure.

Citing, In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991); *see also* MPEP § 2143-§ 2143.03 for decisions pertinent to each of these criteria.

Applicants respectfully submit that independent claim 1 and 8 are not obvious in view of any hypothetical combination of the AAPA, Ho and Reid for the following reasons.

AAPA merely discloses performing a copper electroplating process to film a damascene pattern with copper layer. AAPA teaches nothing about using any type of electroplating process to polish a copper layer. AAPA teaches nothing about reversing the polarity of the current or power applied during the electroplating process to fill a damascene pattern with copper and then reversing that polarity to polish the copper layer, all sequentially and within the same electroplating apparatus.

In an attempt to supplement this deficiency with AAPA, the Patent Office turns to Ho and Reid. However, Ho merely teaches the use of the copper layer 220 as an anode. Ho teaches nothing about carrying out electroplating process to deposit copper by applying current of one polarity to the substrate and then reversing the polarity to polish the copper, with both processes being carried out sequentially in an electroplating apparatus. Instead, Ho teaches the formation of the initial copper layer by “thermally assisted deposition methods, electron beam assisted deposition methods, PVD sputtering methods and CVD methods.” See paragraph 0036. Further, the Ho polishing process includes a combination of CMP that is merely assisted by current. This is referred to as the electro-dissolution polish (EDP) method.

In stark contrast, claims 1 and 8 require the initial deposition of copper by an electroplating process using current of another polarity and then polishing that copper also by an electroplating process by reversing the polarity of the current or power.

While the initial electroplating deposition is taught by AAPA, Ho teaches against the initial electroplating deposition by only teaching thermally assisted, electron beam assisted, PVD and CVP deposition methods. The AAPA, as admitted by the Patent Office, does not teach or suggest polishing the copper layer by an electro-polishing process in an electroplating apparatus by changing the negative power supply to a positive power supply as recited in amended claims 1 and 8. Ho also teaches against this as Ho only teaches a EDP method which is primarily a CMP process that uses current. Ho in no way teaches or suggests reversing the polarity of current or the power supply to convert from electro-

deposition to an electro-polishing process. The AAPA also fails to teach or suggest this reversing of the polarity of the current or converting from a negative power supply to a positive power supply as recited in independent claims 1 and 8.

Therefore, no combination of Ho and the AAPA teaches or suggests every element of independent claim 1 or 8, there is no suggestion or motivation to modify the polishing process of Ho to remove the CMP aspect thereof and then combine Ho with the AAPA in the manner suggested by the Patent Office, and there is no reasonable expectation of success if such a strange combination were made. Still further, any proposed hypothetical combination of Ho and the AAPA would come up short because of the failure to teach or suggest the switching of the power supply from a negative during the deposition to a positive during the polishing as recited in independent claims 1 and 8.

Therefore, Applicants respectfully submit that the rejection of claims 1-6 and 8-12 based upon the combination of AAPA and Ho is improper and should be withdrawn.

With respect to claim 13, the Patent Office also further relies upon Reid. However, Reid is only cited for the proposition that it teaches a specific current range. Reid is not directed toward a combined method of electroplating in an electroplating apparatus followed by an electro-polishing process in the same electroplating apparatus by changing the negative power supply to a positive power supply as recited in independent claims 1 and 8. Reid is only directed toward electrochemical planterization and not electro-deposition or electro-polishing. Reid in no way teaches or suggests the stopping of the electro-polishing process if a copper barrier metal layer is exposed as recited in amended claim 13. Thus, because Reid cannot supplement the deficiencies of Ho and the AAPA as cited above and further because it does not teach or suggest the stopping element of amended claim 13, Applicants respectfully submit that the obviousness rejection of claim 13 based upon AAPA, Ho and Reid is improper and should be withdrawn.

With all rejections having been traversed, Applicants respectfully submit that this application is in a condition for allowance and an early action so indicating is respectfully requested.

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Respectfully submitted,

By 

Michael R. Hull

Registration No.: 35,902

MARSHALL, GERSTEIN & BORUN LLP

233 S. Wacker Drive, Suite 6300

Sears Tower

Chicago, Illinois 60606-6357

(312) 474-6300

Attorney for Applicant